The Crop Evaluation Research for Environmental Strategies (CERES) Remote Sensing 2008 Project Activities

Joseph C. Casas[1], John A. Glaser[2], Kenneth L. Copenhaver[3], George May[3]
[1] *NASA Marshall Space Flight Center, USA;* [2]*U.S .Environmental Protection Agency, USA;* [3] *Institute for Technology Development, USA*
joseph.c.casas@nasa.gov

In recent years, the use of Plant Incorporated Protectant (PIP) corn by American producers has been increasing dramatically. PIP corn contains genetically inserted traits that produce toxins in the plant that provide narrowly targeted protection against specific insect pests. The plant producing t oxins can offer significant reductions in the application of broad -spectrum pesticides that have ecological and human health consequences. PIP corn as a percentage of total corn acreage planted in the US is expected to continue to increase as these protective traits are "stacked" with other desirable traits by seed companies, and producers are seeing considerable increases in corn yield as a result. The introduction of corn as a bio-fuel source for ethanol has increased production by over 6 million hectares i n 2007. The United States Environmental Protection Agency (USEPA), which is responsible for the registration of PIP crops under the Federal Insecticide, Fungicide and Rodenticide Act, views the use of PIP corn as positive. Broad spectrum pesticide use has declined since the PIP traits have been introduced. As the agricultural landscape sees a higher percentage of corn acres using the PIP technology, the risk of the targeted insect pest populations developing resistance to the toxins, thereby rendering the m useless will increase as well. This result would negate the effectiveness of the PIP corn traits and could reduce production of a US field corn crop valued at $33 billion dollars in 2006 and place US food and now energy security at risk.

Concerns over insect pest resistance development to PIP traits have led the USEPA to team with NASA and the Institute for Technology Development (ITD) to develop geo-spatial technologies designed to proactively monitor the corn production landscape for insect pest infestation and possible resistance development. USEPA resistance management simulation models are combined with NASA remote sensi ng products to monitor the corn landscape for resistance development. The two agencies have entered into an agreement which could potentially lead to the development of next generation NASA sensors that will more specifically address the requirements of the USEPA's resistance development strategy and offer opportunities to study the ever changing ecosystem complexities. The USEPA/NASA/ITD team has developed a broad research project entitled CERES (Cro p Evaluation Research for Environmental Strategies). CERES is a research effort leading to decision support system tools that are designed to integrate multi-resolution NASA remote sensing data products and USEPA geo -spatial models to monitor the potential for insect pest resistance development from the regional to the landscape and then to the field level.

Within the Crop Evaluation Research for Environmental Strategies (CERES, the Roman Goddess of Harvest) field research activities that are part of agriculture focused ecosystem project activities conducted jointly by the National Aeronautics and Space Administration, (NASA) the US Environmental Protection Agency (USEPA),and the Institute for Technology Development(ITD), the 2008 summer field research observations of corn insect pest infestation and toxin resistance development has indicated textural imagery patterns obtained by hyperspectral remote instrumentation previously studied and identified as indicative of corn root worm pressure. These areas of the production corn field with potential infestation characteristics and also previously unknown by the farmer were identified from the aircraft imagery. These locations of special interest within the field were identified for trained ground truth scouts to visit, provide GPS tagging and detailed crop observations. Upon visiting the field, the scouts identified lodged corn in these locations. Representative samples of corn stalks were removed and the roots assessed at the University of Illinois. Plant material assays were also taken for the same roots by the scouts. Results for the root ratings and assays can be seen in the images acquired from the flight data. These results indicated that root worm pressure, that is infestation conditions, was experienced well above the allowable tolerance in transgenic corn containing the toxin for elimination of root worm. This root worm pressure is indicative of a potential failure of the crop effectiveness of toxins at some level. While crop infestation was confirmed, actual potential root worm resistance will require further study. The company that provided the transgenic corn has been notified and is treating the incident with great interest.

CERES is an ecosystem decision support system that is designed to integrate multi-resolution NASA remote sensing data products and EPA geo-spatial models to monitor the potential for insect pest resistance development from the landscape to the field level. At the current stage of development, the decision support system consists of three tiers. Space-based sensors are expected to provide wide area surveillance, airborne sensors are tasked with the monitoring of local conditions and in-field inspection teams provide the final discernment of insect pest resistance development.